Modeling and simulation of heat and mass transfer in oil palm fruit digestion process

ABSTRACT

This paper describes a model and simulation of heat transfer and mass transport phenomena during digestion process of oil palm fruits using Comsol Multiphysics software ver. 4.4. Prior to the simulation, some experimental works were conducted to measure water and oil transport and heat transfer. The measured average water diffusivity coefficients of sterilised oil palm fruits were 3.03E-09 m2/s, 2.4545E-08 m2/s, and 9.433E-09 m2/s for intact fruits, a-b axis sliced, and c-axis sliced fruits respectively. The diffusivity coefficients of oil release from mesocarp were 1.04E-08 m2/s, 4.5578E-09 m2/s, and 4.083E-09 m2 /s respectively. For simulation purposes, the fruit was modeled as a half ellipsoid shape. Digestion time was 30 minutes and the initial bulk and fruit temperatures were at 95oC and 28oC respectively. It was proven in both experiment and simulation that rupturing fruits had significant impact on higher water absorption to the mesocarp and more oil released from the fruit. Based on both simulation and experiment, the fruit reached uniform temperature of 95 oC after five minutes of heating.

Keyword: Digestion process; Oil palm fruit; Model; Comsol multiphysics; Simulation